

# The state of Hardware Video Codecs in Linux

Andrzej Pietrasiewicz  
Nicolas Dufresne

andrzej.p@collabora.com  
nicolas@collabora.com

# About the authors



Nicolas

Principal SWE @ Collabora

Top GStreamer contributor

Kernel codec uAPI and driver contributor



Andrzej

Senior SWE @ Collabora

Codec driver writer

VP9 stateless decoding uAPI co-author



COLLABORA

Open First

# Agenda

- What is a [hardware] codec?
- What kinds of codecs are there?
- How did we get here?
- What is ahead?



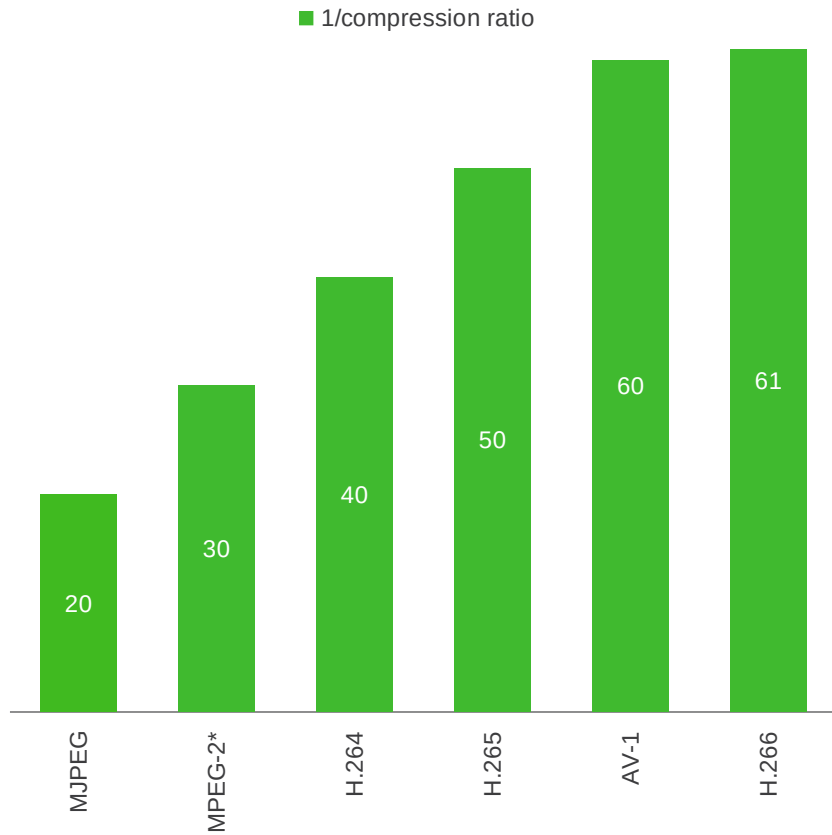


# What is a [hardware] codec?

# What is a [hardware] codec?

- A specification
- An implementation of the spec

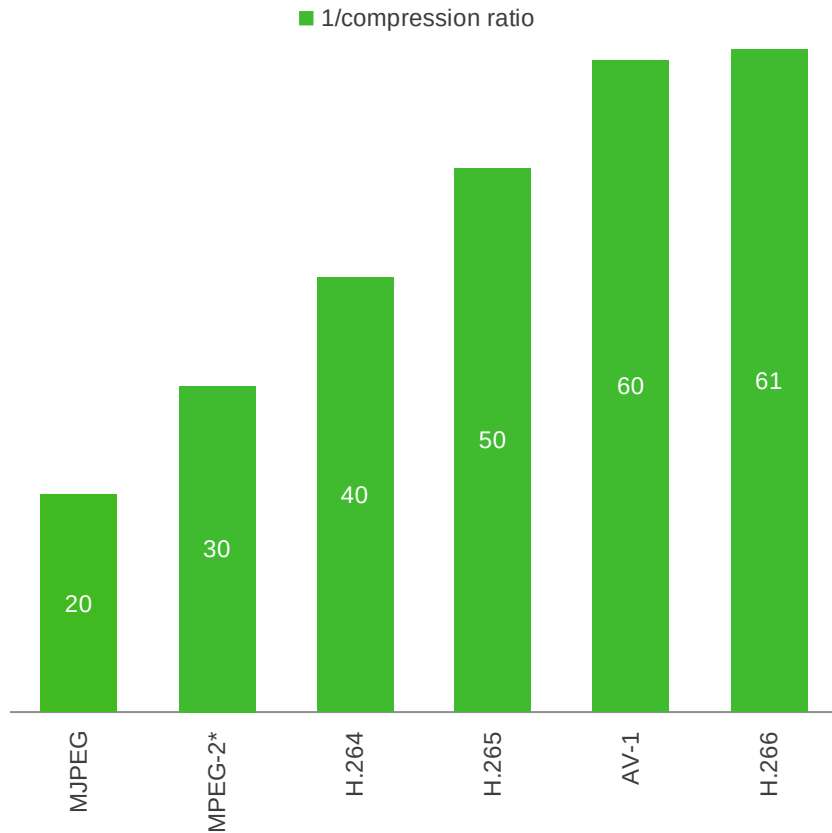
# Codec progression



COLLABORA

Open First

# Codec progression



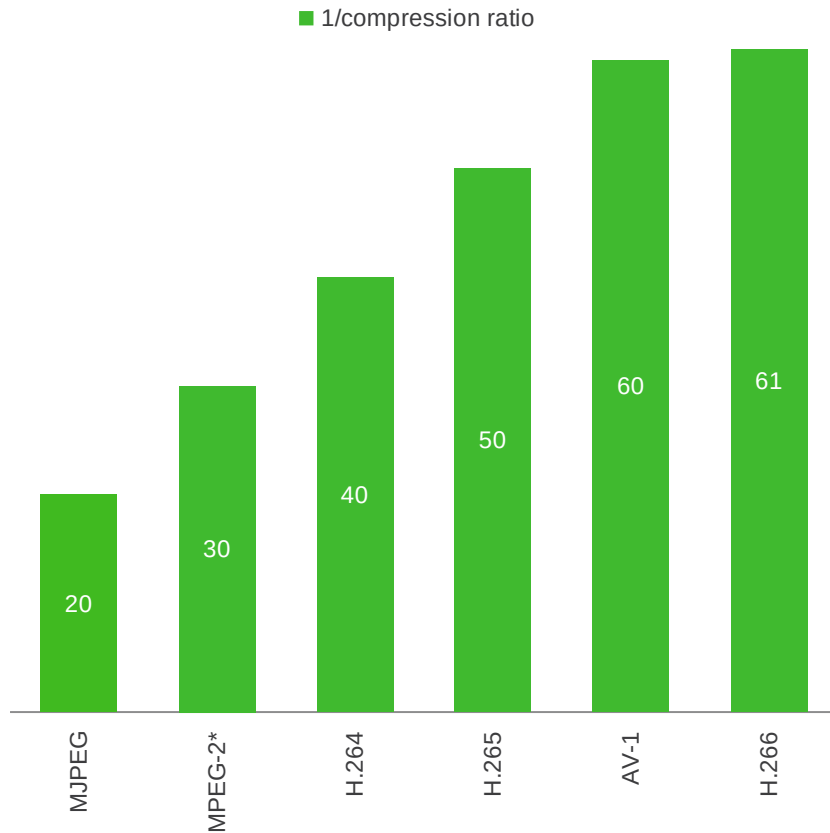
rough estimates



COLLABORA

Open First

# Codec progression



rough estimates

hardware assistance expected



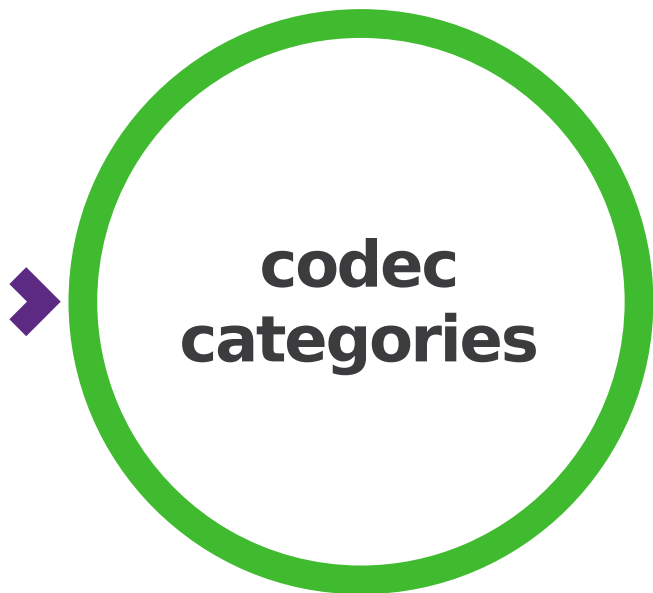
COLLABORA

Open First





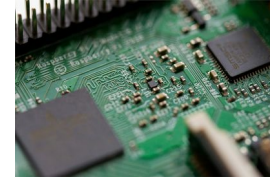
# What kinds of codecs are there?



	DECODER	ENCODER
STATEFUL		
STATELESS		

[EOSS 2023 Prague](#)

# Applications



COLLABORA

Open First

# Some codecs driven by usptream drivers

Codec	Who	What
Coda 960	Safran (former Zodiac)	Aircraft infotainment
	BOSCH	Car infotainment
	Agbrain	Farm tractors
Venus	Qualcomm	ChromeOS, Android
Wave5	C&M, TI chips	Automotive-oriented
MFC	Samsung	Android, chromebook, Hardkernel
tegra	nvidia	Drones
rkvdec/rkvenc	Rockchip	Set top/media boxes
hantro/verisilicon	NXP	Automotive (when in iMX.8)
	Safran	Infotainment
	Blaize	AI
	Intel Movidius	AR
	ST Micro	STM32MP25
	Microchip	SAMA5D4
venc/vdec	Mediatek	ChromeOS

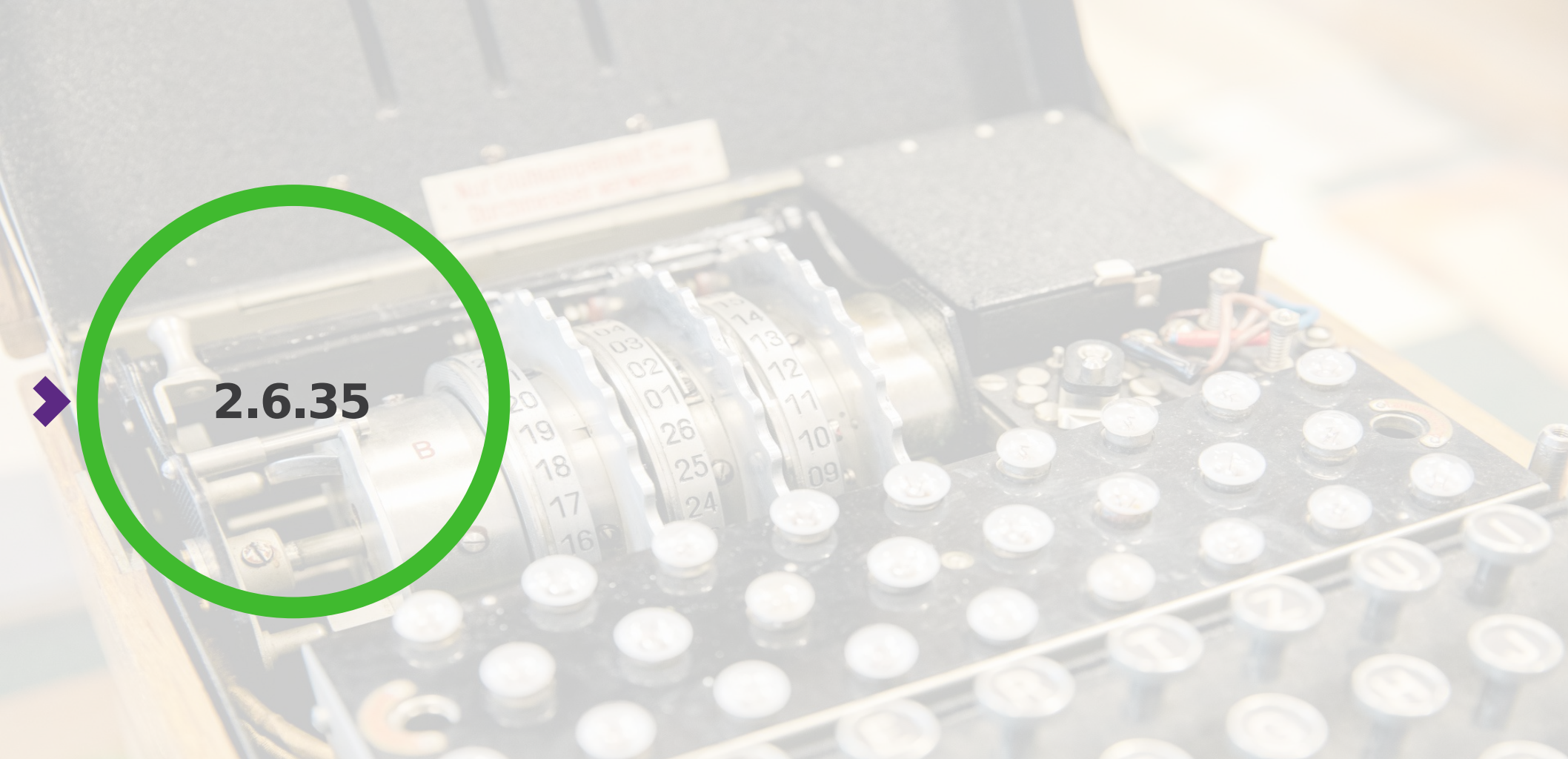


# Recap

- Codec
- Growing efficiency => growing complexity
- Upstream drivers in action



# How did we get here?

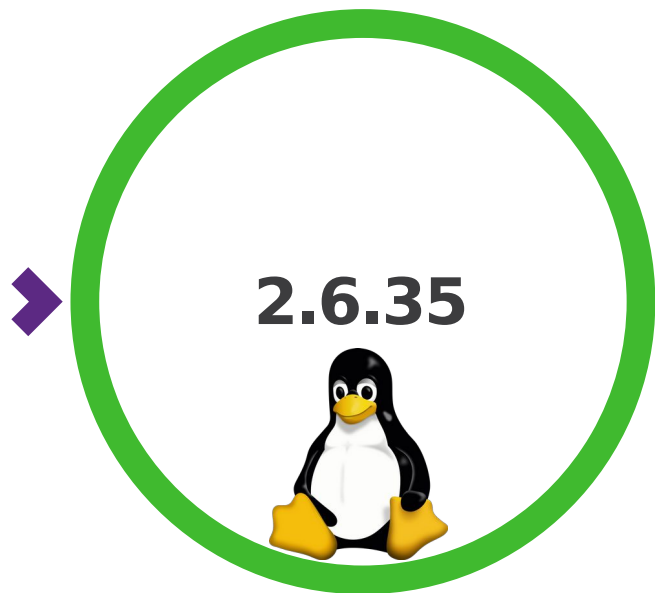


2.6.35



COLLABORA

Open First



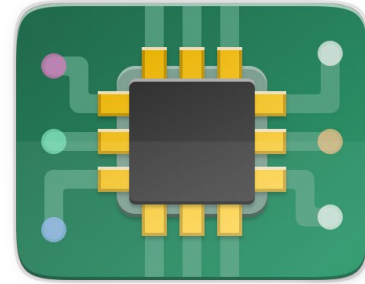
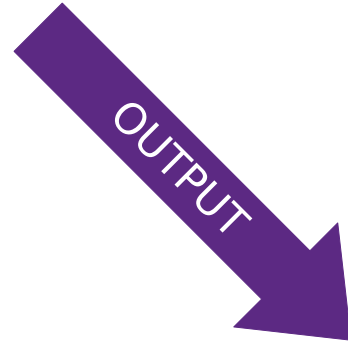
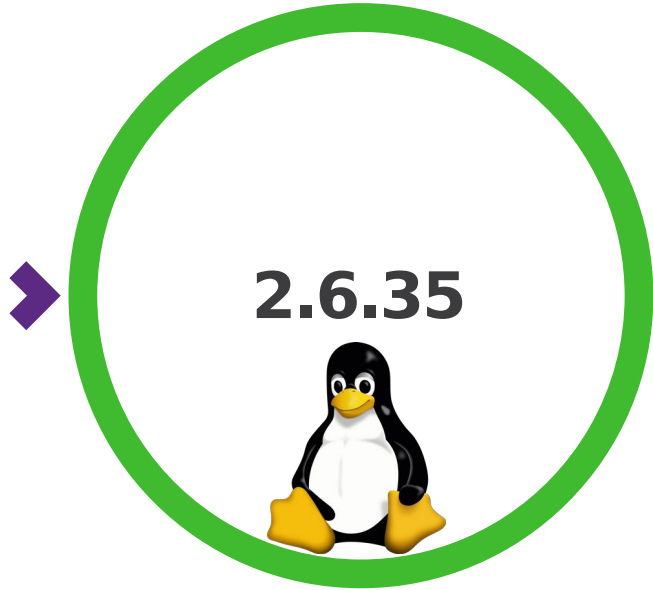
Kernel release

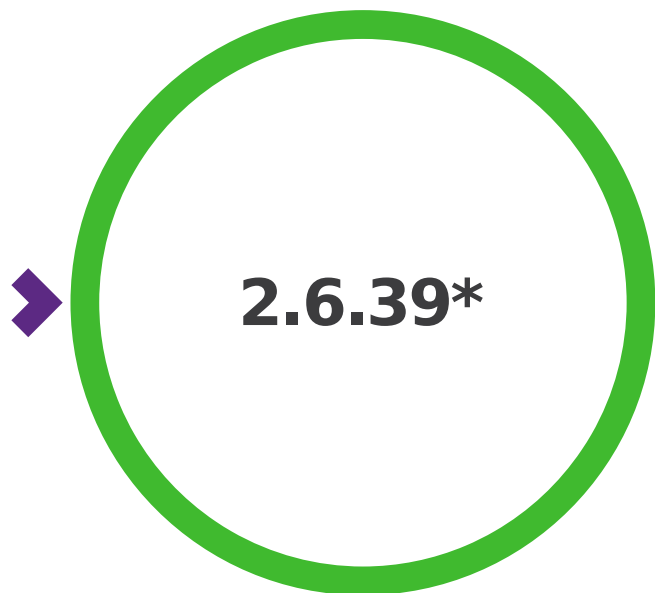
~2010

Paweł Ościak &  
Marek Szyprowski  
mem2mem



# mem2mem

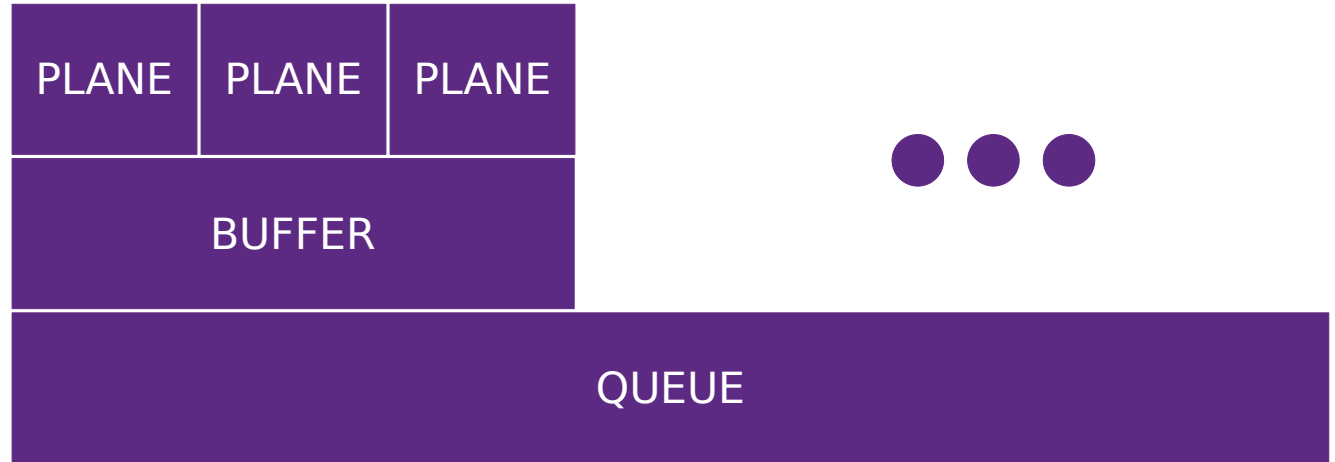




Early 2011

Paweł Ościak &  
Marek Szyprowski  
videobuf2

# videobuf2





**3.1**

Late 2011

Kamil Dębski

MFC

s5pv210, Exynos4

Stateful H.264 enc/dec



COLLABORA

Open First



3.3

Early 2012

Andrzej Pietrasiewicz

JPEG

s5pv210, Exynos4



COLLABORA

Open First



Later 2012

Javier Martin for Chips&Media

Coda

Stateful MPEG4 and H.264 enc



COLLABORA

Open First



De-facto stateful codec uAPI

Spec merged

Tomasz Figa

2019 (stateful decoders)

2020 (stateful encoders)



Stateless decoders discussed

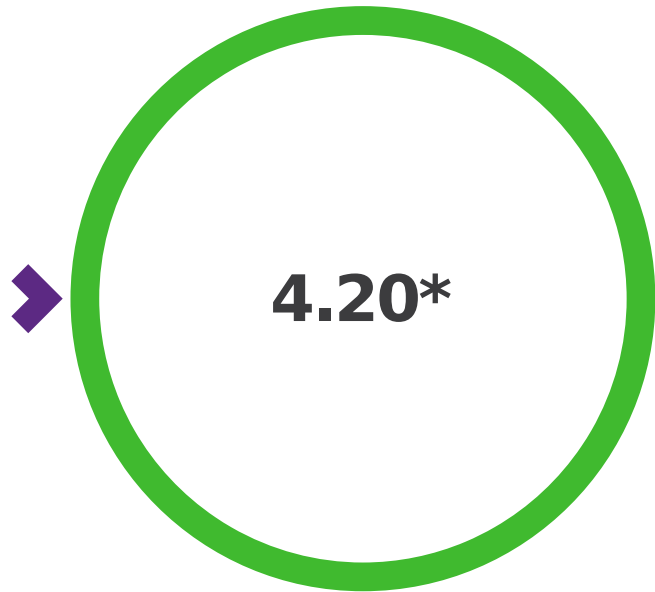
Spec merged

Alexandre Courbot

2019 (stateless decoders)





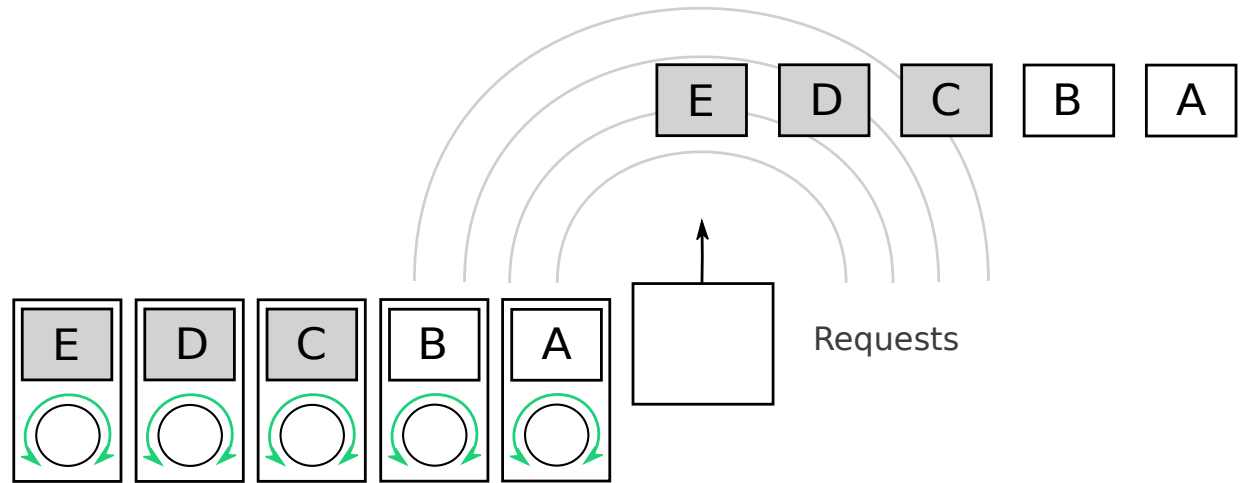
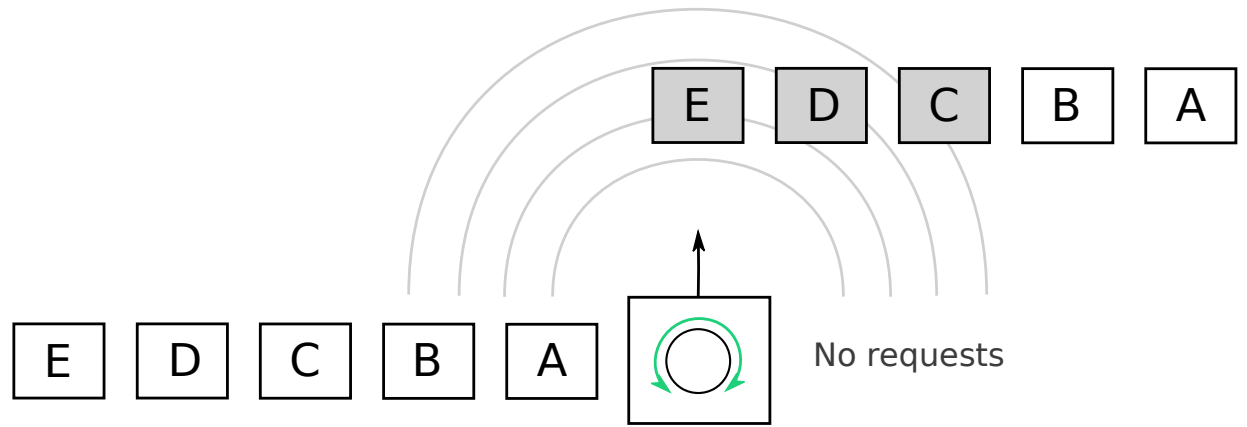


2018

Hans Verkuil

Request API

# 4.20





4.20

2018

Paul Kocialkowski

Cedrus

VideoEngine/Allwinner

Stateless MPEG-2 dec



COLLABORA

Open First



~ 10 video codec drivers  
+ staging  
Variants!



# Proper codec driver submission

- v4l2-compliance report
- Fluster [github.com/fluendo/fluster/](https://github.com/fluendo/fluster/) score (decoders)
- A working driver would be nice 😊



# What is ahead?

# Pending work

- Stateless encoders spec & drivers
  - RFC VP8 driver mid 2023 (Andrzej Pietrasiewicz@Collabora)
  - RFC H.264 driver end 2023 (ST Micro in cooperation with Collabora)
  - Spec missing



# Pending work

- Venus replacement
  - Venus→Iris
  - Likely will not use mem2mem





# Pending work

- RPi stateful codec
  - MMAL
  - H.264 and MJPEG encode & decode
  - MPEG4, H.263 and VP8 decode
  - MPEG2 decode (license?)



# Pending work

- C&M new Wave5 features
  - 422 subsampling support
  - 10-bit support
  - HEVC High Profile support
  - New encoder controls (e.g. ROI)
- Wave6?



# Future

- New codecs
  - rk3588 8k
  - rk3399 encoder/decoder



# Future

- More codec conformance tests
  - Decoders - fluster
  - Encoders - ?



# Distant future

- mem2mem criticism & follow-up
  - Dates back to a historic kernel release
  - Not all M2M drivers use mem2mem



# Distant future

- Convergence of stateless and DRM
  - Workflow of using DRM/GPUs and stateless codecs is similar
  - Vulkan video



# Summary

- What is a [hardware] codec?
- What kinds of codecs are there?
- How did we get here?
- What is ahead?



**Thank you!**





**We are hiring**  
**[col.la/careers](https://col.la/careers)**



COLLABORA

**Open First**